Docket No.: APA-0215

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Yasuhide Otsu et al.

Application No.: NEW APPLICATION | Art Unit: N/A

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For: METHOD AND APPARATUS FOR PROCESSING BRITTLE MATERIAL

A LETTER OF CLARIFICATION OF ARTICLE 19 AND 34 AMENDMENTS

MS PCT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

To assist the U.S. Patent and Trademark Office in interpreting the English Translation of the Article 19 and 34 Amendments, the following represents the Article 34 Amendment as it applies to the English language specification, as the English language Translation of the Article 19 and 34 Amendments applies to the Japanese language specification.

AMENDMENTS TO THE SPECIFICATION

1. On page 3, please replace the paragraphs starting on line 19 with the following paragraphs:

~~According to the present invention, a method for processing brittle material in which a laser light from a laser light source irradiates the brittle material and an irradiating position of the laser light is moved along a predetermined line comprises irradiating simultaneously the laser light from a plurality of the laser light sources onto the brittle material, and moving an irradiating range of the laser light, which is set to a predetermined shape, over a surface of the brittle material.~~

~~In the processing method according to the present invention, it is preferable that a plurality of optical wave guides (for example hollow optical fibers or hollow wave guides) that guide the laser light from the laser light sources to the brittle material are provided, and composite laser light irradiates the surface of the brittle material, with these optical wave guides bundled together.~~

~~In the processing method according to the present invention, it is possible to employ a method in which a plurality of laser light sources of differing output intensities are combined, and a composite intensity distribution of the laser light that irradiates the surface of the brittle material is adjusted. Further, it is also possible to employ a method in which an irradiating spot position of the plurality of laser lights on the surface of the brittle material is set so as to obtain the intended shape of the beam of the laser light irradiated onto the brittle material.~~

~~Furthermore, it is also possible that a time at which light emission of the plurality of laser light sources starts is controlled with a predetermined sequential time lag, so as to sequentially move the irradiating spot position of the plurality of laser lights.~~ According to the present invention, a method for cutting brittle material by irradiating laser light from a laser light source onto a brittle material to generate thermal distortions over a wide range of the brittle material, providing cracks in the interior of the brittle material and moving that irradiating position along a predetermined line of the brittle material to cut the brittle material, comprises providing a plurality of optical fibers which guide laser lights from a plurality of laser light sources to the brittle material; driving the plurality of laser light sources, with the plurality of optical fibers in a

bundled condition such that irradiating spots of the lights irradiating the brittle material are arranged in a matrix arrangement, for irradiating a composite laser light which achieves a predetermined shape onto the surface of the brittle material; and adjusting a light intensity distribution of this composite laser light by controlling respectively the light intensity of the plurality of the laser light sources.

In this method, it is preferable to set the shape of the composite laser light by selectively driving the plurality of laser light sources.

Furthermore, it is also possible to set the shape of the composite laser light by selecting a method for bundling the plurality of optical fibers.

Moreover, it is also possible to set the plurality of laser light sources to different output intensities.

Furthermore, it is also possible to set the shape of the composite laser light by controlling an emission start time of the plurality of light sources to a predetermined sequence of time differences.

2. On page 6, please replace 2nd paragraph with the following paragraph:

~~According to the present invention, an apparatus suitable for carrying out the brittle material process method having the characteristics described above, in which a laser light from a laser light source irradiates the brittle material and an irradiating position of the laser light moves along a predetermined line, comprises a plurality of laser light sources, an optical wave guide for guiding a laser light from those laser light sources to a surface of the brittle material, a scanning means for moving a laser light irradiating position to the brittle material, a light intensity measuring means for measuring the light intensity on a laser light irradiating face of the brittle material; and a transporting means for transporting the light intensity measuring means along the laser light irradiating face of the brittle material, wherein the apparatus for processing the brittle material is configured so as to use an output from the light intensity measuring means as measured information of a composite intensity distribution of the plurality of laser lights irradiated onto the surface of the brittle material.~~ According to the present invention, an apparatus suitable for carrying out the brittle material process method having the characteristics

described above, in which laser light from a laser light source is irradiated onto the brittle material and that irradiating position is moved along a predetermined line, comprises a plurality of laser light sources; a plurality of optical fibers, bundled so as to guide the laser light from each laser light source to a surface of the brittle material, and arranged such that irradiating spots of the laser lights irradiating the brittle material are arranged in a matrix arrangement; and a scanning means for moving a position at which the laser light is irradiated onto the brittle material; wherein the composite laser light which has a predetermined shape is irradiated onto the surface of the brittle material with the plurality of bundled optical fibers, and the light intensity distribution of this composite laser light is adjusted by controlling respectively the light intensity of the plurality of laser light sources.

In this configuration, it is preferable to provide a light intensity measuring means for measuring a light intensity distribution of the composite laser light on the irradiated surface of the brittle material. Moreover, it is preferable to provide a transportation means for transporting the light intensity measuring means along the laser light irradiated surface of the brittle material."

3. On page 7, please replace paragraphs starting on line 21 with the following paragraphs:

FIG. 3, consisting of FIGS. 3A and 3B, is a diagram showing schematically a 3-D optical intensity distribution when laser light from a plurality of laser light sources irradiates a brittle material.

FIG. 4, consisting of FIGS. 4(A) to 4(G), is a diagram showing an example of a beam shape (viewed from above) which can be set when a plurality of laser light sources is used.

FIG. 5, consisting of FIGS. 5(A) to 5(D), is a diagram showing another example of a beam shape (viewed from above) which can be set when a plurality of laser light sources is used.

AMENDMENTS TO THE CLAIMS

1. (Currently amended) ~~A method for processing brittle material in which a laser light from a laser light source irradiates the brittle material and an irradiating position of the laser light is moved along a predetermined line; the method comprising:~~

~~irradiating simultaneously the laser light from a plurality of the laser light sources onto the brittle material, and moving an irradiating range of the laser light, which is set to a predetermined shape, over a surface of the brittle material.~~ A method for cutting brittle material by irradiating laser light from a laser light source onto a brittle material to generate thermal distortions over a wide range of the brittle material, providing cracks in the interior of the brittle material and moving that irradiating position along a predetermined line of the brittle material to cut the brittle material, the method comprising:

providing a plurality of optical fibers which guide laser lights from a plurality of laser light sources to the brittle material;

driving the plurality of laser light sources, with the plurality of optical fibers in a bundled condition such that irradiating spots of the lights irradiating the brittle material are arranged in a matrix arrangement, for irradiating a composite laser light which achieves a predetermined shape onto the surface of the brittle material; and

adjusting a light intensity distribution of this composite laser light by controlling respectively the light intensity of the plurality of the laser light sources.

2. (Currently amended) ~~The method for processing brittle material according to claim 1,~~

~~wherein a plurality of optical wave guides that guide the laser light from the laser light sources to the brittle material are provided, and~~

~~wherein composite laser light irradiates the surface of the brittle material, with these optical wave guides bundled together.~~ The method for cutting brittle material according to claim 1, wherein the shape of the composite laser light is set by selectively driving the plurality of laser light sources.

3. (Currently amended) ~~The method for processing brittle material according to claim 1 or claim 2,~~

~~wherein a plurality of laser light sources of differing output intensities are combined, and a composite intensity distribution of the laser light that irradiates the surface of the brittle material is adjusted.~~ The method for cutting brittle material according to claim 1, wherein the shape of the composite laser light is set by selecting a method for bundling the plurality of optical fibers.

4. (Currently amended) ~~The method for processing brittle material according to claims 1, 2 or 3,~~

~~wherein an irradiating spot position of the plurality of laser lights on the surface of the brittle material is set so as to obtain the intended shape of the beam of the laser light irradiated onto the brittle material.~~ The method for cutting a brittle material according to claim 1, wherein the plurality of laser light sources are set to different output intensities.

5. (Currently amended) ~~An apparatus for processing brittle material in which a laser light from a laser light source irradiates the brittle material and an irradiating position of the laser light moves along a predetermined line, comprising:~~

~~a plurality of laser light sources,~~

~~an optical wave guide for guiding a laser light from those laser light sources to a surface of the brittle material,~~

~~a scanning means for moving a position at which the laser light is irradiated onto the brittle material,~~

~~a light intensity measuring means for measuring the light intensity on a laser light irradiating face of the brittle material; and~~

~~a transporting means for transporting the light intensity measuring means along the laser light irradiating face of the brittle material,~~

~~wherein the apparatus for processing the brittle material is configured so as to use an output from the light intensity measuring means as measured information of a composite intensity distribution of the plurality of laser lights irradiated onto the surface of the brittle~~

~~material.~~ The method for cutting a brittle material according to claim 1, wherein the shape of the composite laser light is set by controlling an emission start time of the plurality of light sources to a predetermined sequence of time differences.

6. (Currently amended) ~~The method for processing brittle material according to claim 4, wherein a time at which light emission of the plurality of laser light sources starts is controlled with a predetermined sequential time lag, so as to sequentially move the irradiating spot position of the plurality of laser lights.~~ An apparatus for cutting brittle material by irradiating a brittle material with a laser light from a laser light source and moving that irradiating position along a predetermined line of the brittle material, comprising:

a plurality of laser light sources;

a plurality of optical fibers, bundled so as to guide the laser light from each laser light source to a surface of the brittle material, and arranged such that irradiating spots of the laser lights irradiating the brittle material are arranged in a matrix arrangement, and

a scanning means for moving a position at which the laser light is irradiated onto the brittle material,

wherein the composite laser light which has a predetermined shape is irradiated onto the surface of the brittle material with the plurality of bundled optical fibers, and the light intensity distribution of this composite laser light is adjusted by controlling respectively the light intensity of the plurality of laser light sources.

7. (Currently amended) ~~The apparatus for processing brittle material according to claim 6, further comprising:~~

~~a light intensity measuring means for measuring a light intensity distribution of the composite laser light on the irradiated surface of the brittle material.~~ The apparatus for cutting brittle material according to claim 6, further comprising:

a light intensity measuring means for measuring a light intensity distribution of the composite laser light on the irradiated surface of the brittle material.

8. (Currently amended) ~~The apparatus for processing brittle material according to claim 6, further comprising:~~

~~a transportation means for transporting the light intensity measuring means along a laser light irradiated surface of the brittle material.~~ The apparatus for cutting brittle material according to claim 7, further comprising:

a transportation means for transporting the light intensity measuring means along the laser light irradiated surface of the brittle material.

9. (New) A method for cleaving brittle material wherein thermal distortions are generated over a wide range of the brittle material by irradiating laser light from a laser light source onto a brittle material, and a crack formed at a starting point of processing the brittle material is advanced by moving that irradiating position along a predetermined line of the brittle material to cleave the brittle material, the method comprising:

providing a plurality of optical fibers which guide laser lights from a plurality of laser light sources to the brittle material;

driving the plurality of laser light sources, with the plurality of optical fibers in a bundled condition such that irradiating spots of the laser lights irradiating the brittle material are arranged in a matrix arrangement, for irradiating a composite laser light which achieves a predetermined shape onto the surface of the brittle material; and

adjusting a light intensity distribution of this composite laser light by controlling respectively the light intensity of the plurality of the laser light sources.

10. (New) The method for cleaving brittle material according to claim 9, wherein the shape of the composite laser light is set by selectively driving the plurality of laser light sources.

11. (New) The method for cleaving brittle material according to claim 9, wherein the shape of the composite laser light is set by selecting a method for bundling the plurality of optical fibers.

12. (New) The method for cleaving brittle material according to claim 9, wherein the plurality of laser light sources are set to different output intensities.

13. (New) The method for cleaving brittle material according to claim 9, wherein the shape of the composite laser light is set by controlling an emission start time of the plurality of light sources to a predetermined sequence of time differences.

14. (New) An apparatus for cleaving brittle material by irradiating the brittle material with a laser light from a laser light source and moving that irradiating position along a predetermined line of the brittle material, comprising:

a plurality of laser light sources;

a plurality of optical fibers, bundled so as to guide the laser light from each laser light source to a surface of the brittle material, and arranged such that irradiating spots of the laser lights irradiating the brittle material are arranged in a matrix arrangement, and

a scanning means for moving a position at which the laser light is irradiated onto the brittle material,

wherein the composite laser light which has a predetermined shape is irradiated onto the surface of the brittle material with the plurality of bundled optical fibers, and the light intensity distribution of this composite laser light is adjusted by controlling respectively the light intensity of the plurality of laser light sources.

15. (New) The apparatus for cleaving brittle material according to claim 14, further comprising:

a light intensity measuring means for measuring a light intensity distribution of the composite laser light on the irradiated surface of the brittle material.

16. (New) The apparatus for cleaving brittle material according to claim 15, further comprising:

a transportation means for transporting the light intensity measuring means along the laser light irradiated surface of the brittle material.

REMARKS

This Letter essentially restates the Article 19 and 34 Amendments as it would apply to the English language specification.

Accordingly, claims 1-16 are presented for examination at this time. No new matter has been added.

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Respectfully submitted,

By _____

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